GLACIOLOGICAL AND VOLCANOLOGICAL STUDIES IN THE WRANGELL MOUNTAINS, ALASKA

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July 31, 1973

Second Semi-Annual Technical Report, February-July, 1973
NASA Contract NAS5-21833
ERTS Project 110-13

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Goddard Space Flight Center
Greenbelt, Maryland 20771

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
6		

4. Title and Subtitle	5. Report Date
Glaciological and Volcanological Studies in the Wrangell Mountains, Alaska	August 30, 1973
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Carl S. Benson and Lewis H. Shapiro	
9. Performing Organization Name and Address	10. Work Unit No.
Geophysical Institute University of Alaska	11. Contract or Grant No. NAS5-21833
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	Type II Feb.1973-July 1973
National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt, Maryland 20771	14. Sponsoring Agency Code

15. Supplementary Notes

One of 12 ERTS-1 projects conducted by the University of Alaska;
ERTS-1 project GSFC No. 110-13
Principal Investigator, GSFC ID No. UN594

16. Abstract

The objectives of this project are two-fold: to develop methods of monitoring the interaction between volcanic heat and the snow and ice cover of Mt. Wrangell and, to evaluate the potential applicability of ERTS data to studies of the mass balance of the entire 5000 km^2 ice cap in the Wrangell Mountains. The emphasis of our investigations since we began receiving data has been directed towards assessing the applicability of ERTS data to the project objectives, and determining the most efficient methods of extracting the required information from the ERTS images.

During the past reporting period investigations of enhancement and information extraction methods were continued. In addition, ground truth data were acquired to provide information with which we hope to determinate the spatial limits within which changes in snow cover at the summit of Mt. Wrangell can be defined.

17. Key Words (Selected by Author(s))	18. Distribution Statement
Glaciology Volcanology	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	7	

CONTENTS

	Page
Introduction	1
Status of the Project	
A - Objectives	1
B - Accomplishments during the Reporting Period	2
Plans for Next Reporting Period	4
Conclusions	5
Recommendations	5
Publications	5
References	5
Appendix A	6
Appendix B	6
Appendix C	6
Appendix D	7

I. Introduction

This report summarizes the work performed and conclusions reached during the second six month period of Contract No. NAS5-21833, University of Alaska ERTS-1 project No. 110-13, "Glaciological and Volcanological Studies in the Wrangell Mountains, Alaska".

During this reporting period we have continued to evaluate the applicability of ERTS data to the objectives of this project. However, we have gone beyond this stage by becoming more operational with the data. Photographs from various sources have been examined and we have continued to experiment with enhancement techniques on the ERTS data. Contouring of the printouts of the digital tapes appears to be the most promising approach to interpretation of images from the summit area.

As we have noted in previous reports, funding for this project is minimal and provides for only 1-1/2 months of principal investigator time. As a result, we have tended to restrict our efforts on the project to those aspects of the study which appear most likely to give useful results with little investment in time.

II. Status of the Project

A. Objectives

The overall objectives of the project are two-fold: to develop methods for monitoring the interaction between volcanic heat and the snow and ice cover of Mt. Wrangell and, to evaluate the potential applicability of ERTS data to studies of the mass balance of the entire Wrangell ice cap. The emphasis of our investigations during the first six months of the contract period was directed towards assessing the applicability of the ERTS data to the project objectives and determining the most efficient means of extracting the required information from the ERTS images.

B. Accomplishments during the Reporting Period

In previous reports, we indicated that we believed that it is possible to monitor changes in the snow and ice cover at the summit of Mt. Wrangell which can be attributed to volcanic heating. Data acquired by the ERTS-1 satellite during the past spring verifies this conclusion. Images taken on 28 April, clearly show bare rock outcrops in the active crater and north crater, and the area of rock exposed appears to be greater than that visible on images taken during October 1972. At least a meter of new snow-accumulation occurred at the Summit over this time interval. Its absence can only be attributed to volcanic heat. The most important question remaining regarding the applicability of the data to this objective of the project is to define the extent of change which can be recognized from the ERTS images. This requires that ground truth be available from which the limits of the snow cover can be mapped and compared with that shown on the ERTS data, and further that such data be available for different time periods. The NASA flight in support of this project in late July 1972, provided ground truth for the summer of 1972. A clear ERTS image of the summit area was acquired on 2 August, 1972, with which the NASA photographs can be compared. The acquisition of similar data for the current year was considered to be particularly important. Accordingly, the principal investigator made a flight over the summit area in a charter aircraft on Monday, 9 July 1973. The day was selected to coincide with a pass of the satellite, and fortunately the day was clear and a set of color photographs was obtained. The weather was bad on 8 July and closed in again on the afternoon of 10 July. We have just received some of the data from the satellite pass of 9 July and are beginning to examine it.

In addition to our own photographic coverage infrared scanner and black and white photographic imagery of the summit were also acquired for this study on July 24 by the U. S. Navy. Analysis of these data should be adequate to answer the question posed above.

We have also continued to assemble photographic data from Mt. Wrangell from all available sources.

Investigations into the possibility of mapping snow cover at the summit of Mt.Wrangell directly from computer print-out of the digital tapes of the ERTS data are continuing. Digital printouts of Band 5 from image Number 1062-20221 and of Band 7 from image number 1010-20331 and 1062-20221 have been made. We have done some hand-contouring of these printouts since installation of our Digital Color Display Unit still has not been completed. However, our analysis and hand contouring of the digital printouts has demonstrated that bare rock outcrops can be recognized even in areas of heavy shadow. We have also determined, from this analysis, that the printout of band 5 is most suitable for our needs.

During the past reporting period we received digital tapes of all the clear images of the summit area which were acquired during the summer and autumn of 1972. We have requested the same data for the spring and summer passes of 1973. Analysis of the available data is in progress.

The applicability of the ERTS data to the study of the mass balance of the Wrangell ice cap is still in progress. Examination of the imagery available to date shows that the position of the snow line on glaciers flowing out of the ice cap can be identified. The applicability of the data to this problem, however, depends upon the degree of certainty with which the snow line can be recognized at the end of the melt season. There is some indication that this can be done on the imagery from August and September

1972, but it would be of value to confirm this with data from the autumn of the present year.

We have learned that data are available from Mt. Erebus in Antarctica. As noted in the 5th Bimonthly report, we have requested the imagery which was obtained over Mt. Erebus on 24 December 1972. We are looking forward to receipt of this imagery so that we can begin the comparative study which was part of our original proposal.

IV. Plans for Next Reporting Period

During the next reporting period, the following studies will be in progress:

1. Mapping of snow cover at the summit of Mt.Wrangell from aerial photography acquired during July 1973, and comparison of this data with similar maps for July 1972 and with ERTS images of these same periods in order to determine the limits within which snow cover can be mapped with ERTS imagery.
2. Continuation of investigations into the applicability of digital printout of the ERTS data for mapping snow cover at the summit.
3. The Interpretation Systems, Inc., color display system is presently being installed in the University of Alaska ERTS Data Library, and should be available for use shortly. The applicability of this device for enhancement of data for the purposes of this project will be investigated. We have great hopes for this particular approach.
4. A field trip to the summit of Mt. Wrangell is currently underway and should be completed prior to the submission of the next bi-monthly report. The logistics for this type of expedition are formidable. Few aircraft are available and there are even fewer qualified pilots for ski landing and take-off at the 4000m (14,000 ft) summit. The complexities of logistics combined with bad weather have delayed us.

V. Conclusions

In previous reports we have indicated in our conclusions that the ERTS data will provide sufficient information to meet the project objectives. We still believe this and are presently investigating methods of improving the efficiency of data extraction and organization.

VI. Recommendations

None

VII. Publications

Benson, C. S., 1973, Snow Cover Surveys in Alaska from ERTS-1 Data Proc. of ERTS-1 Symposium on Significant Results from ERTS-1, NASA/GSFC, 5-9 March 1973, Volume 1 Technical Presentations, Section B, p. 1593-1596.

VIII. References

None

APPENDICES

Appendix A - Change in Standing order forms

None

Appendix B - ERTS Data Request Forms

None

Appendix C - ERTS Image Descriptor Forms

None

Appendix D - Significant Results

None

Appendix D

Sixth Bi-Monthly Progress Report

University of Alaska

ERTS Project No. 110-113

August 1973

Principal Investigator: Carl S. Benson

Title of Investigation: Glaciological and Volcanologic Studies on the Wrangell Mountains, Alaska

Disciplines: Mineral Resources, Geologic Structure and Land Form Surveys/ Water Resources

Subdisciplines: Volcano surveys/glacier surveys

Summary of Significant Results: None